should never be mounted on a longitudinal rail within the clear recovery zone. There is a commercially available yielding mailbox support system that will accommodate up to four mailboxes. The cluster mailboxes installed by the U.S. Postal Service do not perform acceptably on impact and should not be installed in the clear recovery zone beside high-speed highways. For more information on mailbox support design and placement, see the *Roadside Design Guide*, Chapter 11, "Erecting Mailboxes on Streets and Highways". Contact Headquarters Office of Traffic Safety Program for approval before the use of non-standard mailbox support design.

Call boxes and chain control signs on steel posts should be mounted on slip-bases where appropriate. Other features in the vicinity should not impede the function of the breakaway device or adversely influence the vehicle response.

7-02.4 Shield the Obstacle

If it is not practical to eliminate, relocate, or make a fixed object break away, then the object should be shielded. All the systems available to shield fixed objects are also fixed objects. They do not prevent an accident but are intended to reduce the severity of the accident. Longitudinal barriers such as guardrail, median barrier, and bridge railing are designed to redirect a vehicle away from its errant path. These barriers have been tested for structural integrity and occupant risk.

Crash cushions are designed to safely decelerate a passenger vehicle to a stop in head-on impacts. When a vehicle strikes the cushions, it expends its kinetic energy by compressing a hydraulic cylinder, compressing or crushing material, tearing metal, displacing sand, or moving a metal cable or strap through a restricted path. Crash cushions are generally used to shield relatively narrow objects such as piers, columns, overhead sign supports, and median barrier installations. A list of approved crash cushions may be obtained from your District Traffic Safety Devices Coordinator, Headquarters' Traffic Operations Liaison or Headquarters' Office of Traffic Safety Program.

Section 7-03 -- Guardrail

7-03.1 Introduction

Guardrail, also referred to as guiderail, is the most common traffic safety system found on California State highways. Guardrail is installed to reduce the severity of run-off-road accidents. This is accomplished by redirecting a vehicle away from embankment slopes or fixed objects and dissipating the energy of the errant vehicle. However, guardrail can reduce accident severity only for those conditions where striking the guardrail is less severe than going down an embankment or striking a fixed object. Guardrail should only be installed where it is clear that accident severity will be reduced, or there is a history of run-off-the-road accidents at this location.

Consideration should first be given to eliminating or minimizing conditions requiring guardrail. This can be done by flattening embankment slopes and by determining alternative locations and designs of roadside appurtenances.

Special consideration should be given to eliminating or relocating solitary fixed objects that cannot be made breakaway or yielding. The cost of eliminating the object may be offset by savings from reduced collision frequency and reduced maintenance. Guardrail required to provide protection at such objects increases exposure and may result in an increase in the number of accidents.

Guardrail is not intended to and should not be used as a barricade or to prevent indiscriminate use of otherwise clear portions of the roadside.

7-03.2 Guardrail Types

Metal beam guardrail is the standard for embankment and fixed object protection.

The approved types of guardrail are:

(1) Metal Beam, and
(2) Concrete.

Concrete guardrail can only be used in place of metal beam guardrail to reduce recurrent delays to motorists caused by lane closures due to maintenance of metal beam guardrail, provide a damage-resistant barrier, and reduce exposure of Maintenance Division personnel to traffic if all the following criteria are met:

1. The proposed location is in a metropolitan area (population is greater than 200,000).
2. The distance from the edge of the traveled way to the face of the guardrail is less than 14 feet.
3. There is less than a 6 hour working window for maintenance work during a 5 day work week, as determined by the District Traffic Operations Branch, based on traffic volume projections of growth for the next 5 years.
4. The proposed location has been struck three or more times in the last year.

Justification for the placement of concrete barrier on new construction should be based on criteria 1 through 3 only.

Under special circumstances, exceptions to these criteria may be granted for metropolitan or rural areas on a case-by-case basis. Exceptions must be approved in writing by a Headquarters' Traffic Operations Liaison.

Three types of approved concrete barrier may be used. Types 50, 60 and 27B are best suited for permanent installations; for temporary or short-term installations, Temporary Railing (Type K) may be used.

The approach end of the concrete barrier must be shielded from traffic. The following are recommended methods of shielding:

1. Bury the end of the concrete barrier in a cut slope.
2. Extend the end of the concrete barrier at a 20:1 or flatter flare to a point outside the clear recovery zone.
3. Install an approved crash cushion at the approach end of the concrete barrier.

Concrete barrier must be anchored to prevent movement. Type 27B is anchored by its continuous footing; Types 50 and 60 require a 10-foot long footing at each end; Temporary railing (Type K) is anchored by four 1-inch diameter dowels, 3 feet long, per section.

Types 50, 60, and Temporary Railing (Type K) should have 2-inch thick asphalt concrete from the edge of the pavement to the back edge of the concrete barrier to prevent erosion. Pavement should extend to the base of the Type 27B rail.

7-03.3 Embankment Guardrail

The primary contributors to the severity of over-embankment accidents are the height and slope of the embankment or side hill. Guardrail is a fixed object and should be installed only at locations where going off the embankment would be more severe than hitting the guardrail, and there has been a history of over-embankment accidents.

The procedure for embankment guardrail consideration at a given location is:

a. *Accidents*. Guardrail should be installed only at locations with a high run-off-road accident history or where there is a significant potential for such accidents. Evaluate the accident history, if available, or the potential frequency of accidents at the location based on the following general considerations:
b. *Alignment*. Isolated curves on otherwise high-standard roads increase the probability of running off the road. Also on roads with curves, run-off-road accidents are more likely to occur on the first curve in a series of curves, successive curves with a speed change greater than 10 mph, curves that are sharper than those generally used, compound curves, or curves with larger central angles. The outside of curves of less than about a 1000-foot radius

and especially those on sustained downhill grades in excess of 2 percent should be given special consideration.

c. *Volume of Traffic*. The higher the volume of traffic, the greater is the probability that run-off-road accidents will occur.

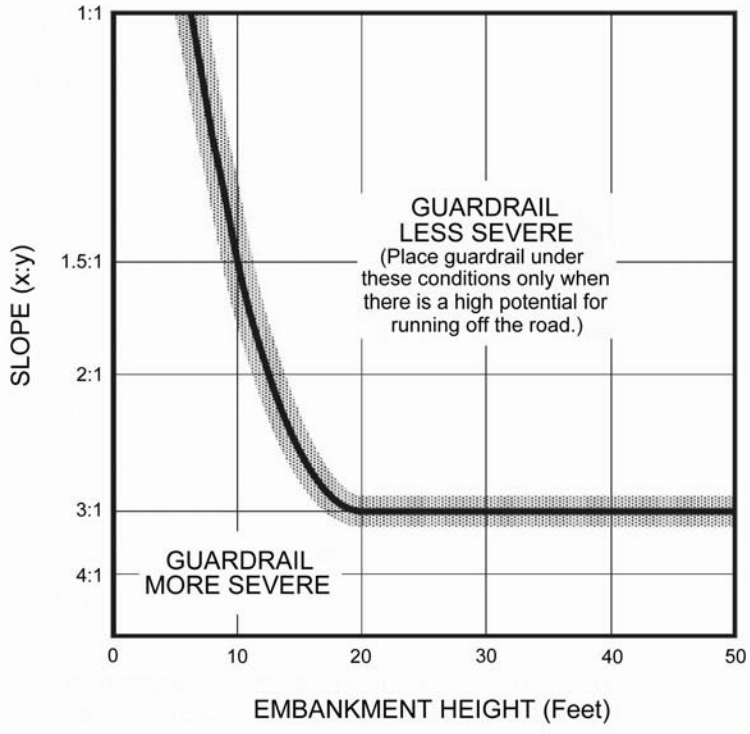
d. *Roadside Recovery Area*. The narrower the recovery area, the greater is the probability that a run-off-road vehicle will go down an embankment.

e. *Climatic Conditions*. Frequent dense fog or snow and ice conditions increase the probability of a vehicle running off the road and going down an embankment. In addition, locations subject to high velocity cross winds have an increased probability of vehicles running off the road.

f. *Severity*. Determine the relative severity of traversing the embankment vs. hitting the guardrail using Figure 7-1, Equal Severity Curve. The Equal Severity Curve was developed from a field review of over-embankment accidents on freeways and full-scale vehicle tests on flatter embankments. The line shown represents combinations of embankment height and slope that result in accident severity's generally equal to average guardrail accident severity. Overall, accident severity will be less if guardrail is used on embankments that plot substantially above the line. Where conditions close to the line are considered**,** accident severity at specific embankment locations may be either greater or less than those of striking guardrail. Thus the curve should be regarded as a band rather than a line.

Based on the accident history or accident potential and the relative severity, decide whether guardrail should be installed.

Figure 7-1
EQUAL SEVERITY CURVE
(See Text for Instructions)



7-03.4 Guardrail at Fixed Objects

Guardrail should be considered at all fixed objects that are accessible to traffic and within the clear recovery zone. Guardrail may also be considered at fixed objects located beyond the clear recovery zone when such objects occupy an otherwise clear recovery area. This applies whether the fixed object is located to the right or left of traffic and includes medians or roadway separations. In some cases, the object of concern may be located outside the right-of-way. Objects with slip-bases or breakaway features and those that yield because of their small size are not considered fixed objects for this application.

The same general principles apply to shielding fixed objects on non-freeways; however, the wide variety of roadside conditions on conventional highways precludes the establishment of firm rules. Lower speed roads require less clear distance. This is discussed in considerable detail in Chapter 3 of the *Roadside Design Guide*. In addition, the installation of guardrail along the roadsides of conventional highways is sometimes incompatible with adjacent property use.

In general, guardrail is not installed to shield fixed objects located behind curbs in urban areas because of lower speeds and the presence of parked cars, poles, hydrants, etc. See the *Highway Design Manual* for recommended horizontal clearances to fixed roadside objects. Individual trees, signal poles, controller cabinets, lighting standards and utility poles are usually not shielded because the guardrail used to provide such protection increases overall fixed object exposure.

Figure 7-2a, Guardrail at Structure Approaches regarding the following applications:

***Structure Approaches*.** This applies to the ends of bridge railings or parapets exposed to approaching traffic. Where guardrail is needed in the cases below, transition railing (Type WB) of the standard plans must be used. If curb or bridge barrier without a vertical face is present, refer to Structures XS Sheets (Barriers and Railings) for connection details.

a. Two-Lane Conventional Highways. When the roadbed width across the structure is less than 40 feet, guardrail should be placed on both sides of the roadbed at each end of the structure. When the roadbed width is 40 feet or more, guardrail should be placed only to the right of approaching traffic. A roadbed is that portion of highway extending from curb line to curb line or shoulder line to shoulder line. Divided highways are considered to have two roadbeds.

b. Multi-Lane Freeways and Expressways with Separate Structures. Guardrail should be placed to the right and left of approaching traffic. Railings, guardrail, and bridge railing should not be placed transversely across the median or separation openings between adjacent or parallel structures. Protection should be provided by bridge approach guardrail with adequate length and an appropriate flare. Details regarding guardrail length and design are contained in the Standard Plans and Section 7-03.5 in the Traffic Manual.

c. Multi-Lane Freeways and Expressways with Decked Medians. When the bridge clear width is less than 60 feet, guardrail should be placed on both sides of the structure. When the bridge clear width is 60 feet or more, guardrail should be placed only to the right of approaching traffic.

Figure 7-2a
GUARDRAIL AT STRUCTURE APPROACHES

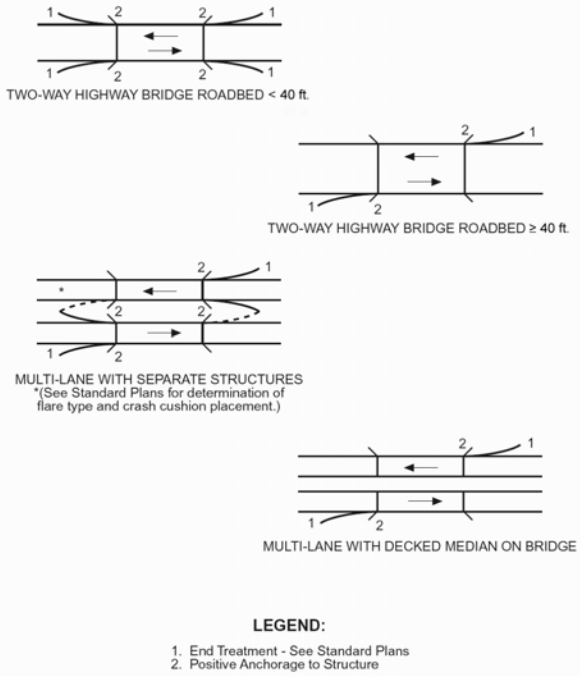


Figure 7-2b, Clear Recovery Zones regarding the following applications:

Roadside Objects and Embankments

a. Guardrail should be placed at the following fixed objects within the clear recovery zone that are not shielded by other traffic safety systems:

(1) Steel overhead sign posts.
(2) Structure piers, columns, and abutments.
(3) Exposed ends of walls.

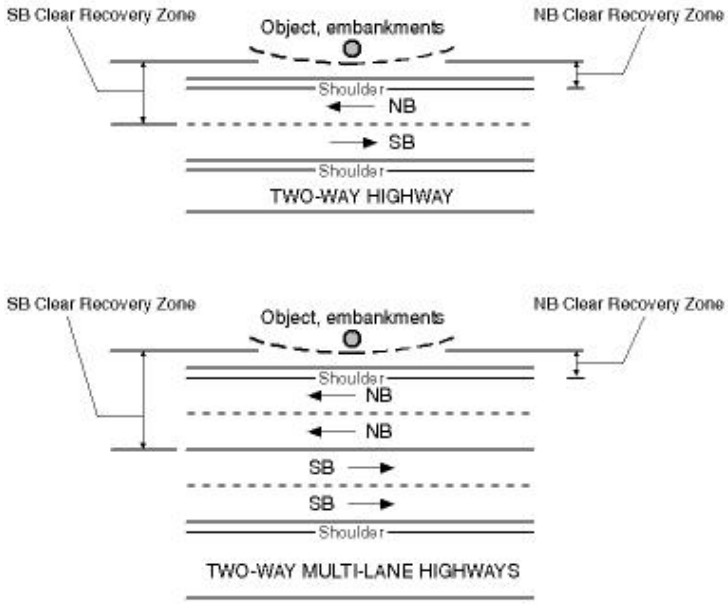
b. Guardrail should be considered for rows of trees with trunks 4 inches or greater in diameter and spaced less than 100 feet apart.

c. Guardrail may be considered at all fixed objects listed in (a) above that are located beyond the clear recovery zone when such objects occupy an otherwise clear recovery area.

d. In medians or roadway separations that are less than 100 feet wide and are traversable by traffic, structure piers or columns should be shielded with guardrail and/or crash cushions.

e. Guardrail placed to shield a fixed object on a two-lane highway shall shield both directions when the object is within the clear recovery zones. Clear recovery zone on the right starts at the beginning of the shoulder and moves right (including the shoulder), and the clear recovery zone on the left starts at the centerline and moves left and will include the opposite traveled lane, the shoulder and beyond. For more information on clear zones on conventional highways, expressways and freeways see Section 7-02 in the Traffic Manual or Figure 7-2b.

Figure 7-2b
CLEAR RECOVERY ZONES



NOTE:

1. Object, embankment within the clear recovery zone should be shielded with the appropriate end treatment.
2. For additional information, please contact your District Traffic Safety Systems Coordinator, Headquarters' Traffic operations Liaison or Headquarters' Office of Traffic Safety Program and Research.

7-03.5 Design Considerations

1. *Length*. Guardrail should only be as long as necessary to provide protection. Guardrail approaching fixed objects should typically have a minimum length of 50 feet preceding the object exclusive of an approved end treatment. Longer lengths of guardrail may be needed on embankments where, in effect, the approach guardrail becomes an embankment guardrail. Where fixed objects are added behind existing guardrail, care should be taken that all fixed objects are within the area shielded by the guardrail. Fixed objects should not be allowed behind breakaway anchors.

2. *Anchorage*. Guardrail functions as a tension member, much like a bowstring, redirecting the errant vehicle away from the obstacle. Thus it is necessary that both ends of all guardrail installations be anchored. When end anchors are damaged in a collision, they should be reconstructed to current standards. Revisions may include extension of the guardrail to place the approach end in a safer location, revision of the approach flare, upgrade of guardrail, removal of dike, or installation of an end treatment.

3. Buried End Anchor. This is the preferred treatment for the approach end of the guardrail. It may be necessary to extend a guardrail installation a reasonable distance to reach a cut section where a buried end anchor can be used. To minimize vaulting, care should be taken that the top of the rail remains at 27 inches above the ground until the cut slope is reached.

4. Anchor Assembly - Type SFT. This anchor is intended for use on the trailing end of guardrail installations. The Type SFT anchor is not intended for breakaway use on the approach end.

5. Anchors Assembly - Type CA. The Cable Anchor Assembly (non-breakaway) shown in the Standard Plans should be used only where the end of a guardrail installation cannot be impacted by an approaching vehicle. An exception is its use at the ends of double barrier and guardrail. No breakaway anchor is currently available for these installations. Also, a non-breakaway anchor should be used to add intermediate anchorage where there is an abrupt change in the alignment of the guardrail, such as when the guardrail is continued down an intersecting road. A breakaway anchor with drilled posts set in a foundation should not be used for intermediate anchorage.

Guardrail approaching structures is anchored to or at the structure. In general, guardrail may be anchored to abutments and structure railings that are designated barrier railings. Guardrail should not be fastened to structure columns. Holes drilled for anchor bolts can compromise the integrity of earthquake reinforcement. Where existing masonry and lightly reinforced concrete walls are involved, an independent anchor should be used. Connections may be made to new installations of concrete barrier.

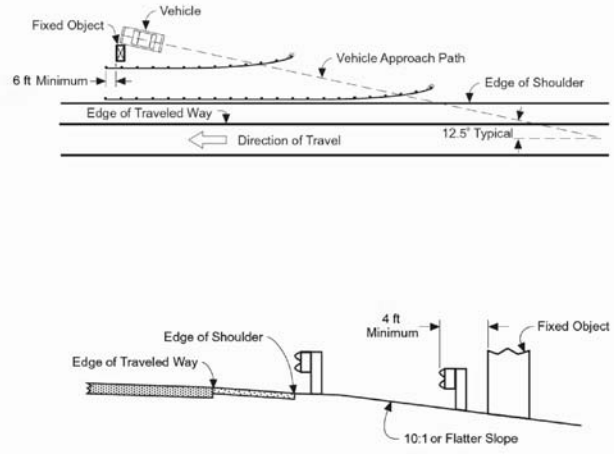
6. End Conditions. In general, the approach end of all guardrail end treatments is shown in the Standard Plans. For more information on which end treatments are approved for use on California State highways and for assistance in choosing an appropriate system, contact your District Traffic Safety Devices Coordinator or Headquarters' Traffic Operations Liaison.

7. Transitions. Metal beam guardrail is a semi-rigid barrier and must be gradually stiffened as it approaches connections to or at rigid objects such as bridge railings, retaining walls, abutment walls, or other structure supports. Gradual stiffening permits an impacting vehicle to be smoothly redirected away from the rigid object. Where guardrail shields fixed objects, gradual stiffening is accomplished by using the “Strengthened Railing Sections for Fixed Object” detail of the standard plans. Transitions at the connection to bridge rail must use the

transition railing (Type WB) of the Standard Plans.

Transitions are required for guardrail approaching structures. Transitions are also necessary where the face of the guardrail is less than 4 feet in front of the rigid object. Such locations may be a structure column, wall, or sign support. Where there is a row of structure columns with less than 26 feet between columns, the reduced post spacing with larger posts should be continued between the columns. Where the column spacing exceeds 26 feet, a new transition may be started.

Figure 7-3
POSITION OF GUARDRAIL AT FIXED OBJECTS



8. *Length and Position*. Nearly all vehicles that run off the road do so at angles less than 25 degrees. The majority of run-off-road accidents occur with departure angles between 10 and 15 degrees, or typically 12.5 degrees. Generally, a 50-foot length of guardrail provides adequate coverage for these conditions. Greater lengths of guardrail, if necessary**,** may be extended along the roadway or away from the roadway in an otherwise clear area. Figure 7-3, Position of Guardrail at Fixed Objects, illustrates how additional guardrail may be needed to shield an area extending back from the edge of the roadbed on a one-way road. Figure 7-3 also illustrates how the length of a guardrail installation may be reduced where there is a clear recovery area between the edge of the shoulder and the fixed object, and the cross slope is 10:1 or flatter. The guardrail may be placed as far as possible from the edge of the pavement, but no closer than 4 feet from the face of the rail to the object. This clearance between the guardrail and the fixed object is necessary, since guardrail deflects up to 3 feet during impact. The extra 1 foot is to allow for those instances where a guardrail post would intrude into the 3-foot clearance. Where an object is so close to the road that guardrail installed with 4 feet of clearance would intrude into the roadbed, it is permissible to fasten the guardrail to the face of the object, other than a structure column, as shown in the Standard Plans. Where guardrail passes within

4 feet of a fixed object the guardrail should be stiffened with the "Strengthened Railing Sections for Fixed Object" detail of the Standard Plans. Where guardrail is connected to a rigid fixed object, the transition railing (Type WB) of the Standard Plans must be used.

Gaps of less than 200 feet between guardrail installations and gaps between the end of cuts and the beginning of guardrail should be avoided. Where such a gap is essential for maintenance purposes, removable rail elements can be installed. For additional information on rail panels, consult the Headquarters' Traffic Operations Liaison or the District Traffic Safety Devices Coordinator. A gap for maintenance use may be left at the departing end of embankment guardrail on one-way roadbeds, or two-way roadbeds where the departure end is outside the clear recovery zone. Where there is recovery area between the edge of the traveled way and the edge of a high embankment, the guardrail should be installed near the edge of the embankment, preserving the recovery opportunity.

To prevent a vehicle from vaulting over guardrail when it is used in conjunction with a curb or dike, the guardrail face should be on a vertical line with the curb face or on line no more than 2 inches behind the flowline of the dike. The sole exception to this is where the end of the guardrail at a bridge approach is blocked out to overhang the bridge curb face. This is done to minimize the possibility of a vehicle's wheel hitting the end of the bridge curb or sidewalk. This case is permitted only if the Headquarters' Traffic Operations Liaison concurs.

As a general rule, a curb or dike greater than 2 inches in height, ditches, drainage structures, and slopes steeper than 10:1 should not be placed in front of guardrail. If a dike is required in front of the guardrail, Type C dike may be used.

Possible vehicle trajectory must be checked where guardrail placement is proposed on an embankment slope steeper than 10:1. A discussion of trajectory may be found in California Department of Transportation Traffic Bulletin No. 15, Method for Checking the Integrity of Cable and Beam Barriers.

9. *Typical Layouts*. Guardrail typical layouts are designed to place the ends of guardrail installations away from approaching traffic and provide a smooth transition. How they are placed is controlled by such factors as embankment width, distance between roadways, clear roadside width, and the design of the guardrail itself. The layouts shown in the Standard Plans are both general and typical. They are most applicable to new construction; however, any installation may require some modification to fit special circumstances. Deviations to recommended guardrail typical layouts must be approved by the Headquarters' Traffic Operations Liaison.

The Type 11 Layout series is intended to shield embankment slopes where guardrail is recommended. Layout Types 11A, 11B and 11C are used where an in-line terminal, flared terminal, and buried end anchor treatment, respectively, are only needed for adjacent traffic. Layout Types 11D, 11E and 11F are used where in-line terminals, flared terminals and buried end anchor treatments, respectively, are needed at both the approach ends and trailing ends of guardrail.

Layout Types 11G and 11H employ combinations of different type end treatments in each layout in which a buried end anchor treatment or in-line terminal, respectively, is needed at the trailing end of guardrail and a flared terminal is used at the approach end.

Layout Types 11I and 11J employ combinations of different type end treatments in each layout in which a buried end anchor treatment or flared terminal, respectively, is needed at the trailing end of guardrail and an in-line terminal is used at the approach end.

Layout Types 11K and 11L employ combinations of different type end treatments in each layout in which an in-line terminal or

flared terminal, respectively, is needed at the trailing end of guardrail and a buried end anchor treatment is used at the approach end.

The Type 12 Layout series is intended to shield the approach or departure ends of structures with various end treatments. Layout Types 12A, 12B and 12C are used where an in-line terminal, flared terminal or buried end anchor treatment, respectively, are used to the right or left of adjacent traffic at structure approaches on two-lane conventional highways, and the roadbed width across the structure is less than 40 feet. These layout types are also used to the right of approaching traffic at the end of each structure on multilane freeways, or expressways with separate bridges or decked median on a bridge.

Layout Type 12D is used where continuous guardrail is installed between structures. Layout Type 12E is used to the left of approaching traffic at the end of each structure on multilane freeways or expressways where a median barrier is not constructed between separated roadbeds.

Layout Types 12AA, 12BB and 12CC are used where an in-line terminal, flared terminal, or buried end anchor treatment, respectively, is needed at structure departures on two-way conventional highways, and where the width across the structure is less than 40 feet. Layout Type 12DD is used to the right of adjacent traffic on two-way conventional highways at a structure departure, where the width across the structure is equal to or greater than 40 feet and guard rail is recommended.

Layouts Type 14A and 15A are used to shield fixed objects between separated roadbeds on multilane freeways or expressways. Layout Type 14A is used where a median barrier is not constructed between separated roadbeds of two-way traffic. Layout Type 15A is used to shield fixed objects in the area between separated one-way roadbeds on multilane freeways or expressways.

The Type 16 Layout series is intended to shield roadside fixed objects. Layout Types 16A, 16B and 16C are used where an in-line terminal, flared terminal and buried end anchor treatment, respectively, shield the approach end of guardrail and are only needed for adjacent traffic.

Layout Types 16D, 16E and 16F are used where an in-line terminal, flared terminal and buried end anchor treatment, respectively, is needed at both the approach end and trailing end of guardrail.

Layout Types 16G and 16H employ combinations of different type end treatments in each layout in which a buried end anchor treatment or in-line terminal, respectively, is needed at the trailing end of guardrail and a flared terminal is used at the approach end.

Layout Types 16I and 16J employ combinations of different type end treatments in each layout in which a buried end anchor treatment or flared terminal, respectively, is needed at the trailing end of guardrail and an in-line terminal is used at the approach end.

Layout Types 16K and 16L employ combinations of different type end treatments in each layout in which an in-line terminal or flared terminal, respectively, is needed at the trailing end of guardrail and a buried end anchor treatment is used at the approach end.

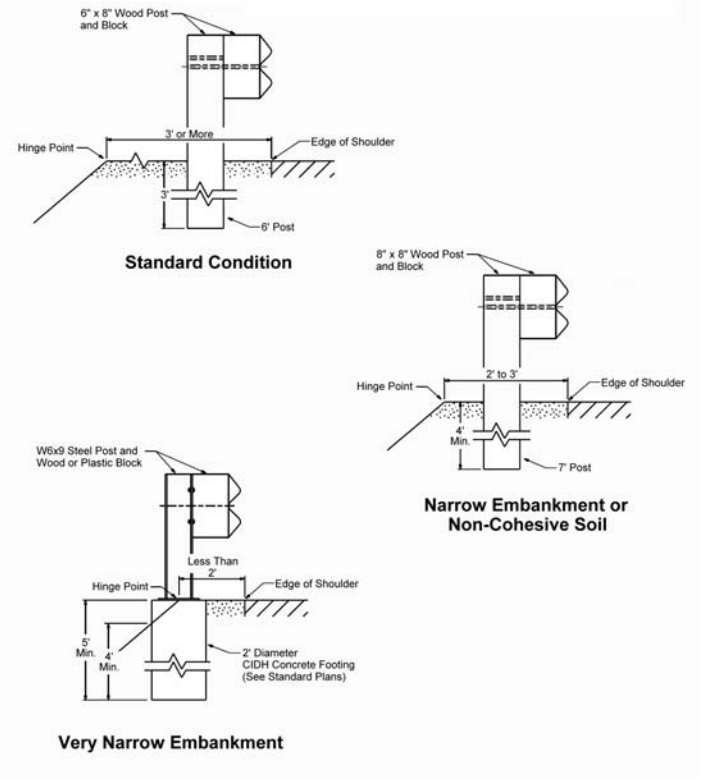
Details. Metal beam guardrail is made up of a 0.108-inch, "W" shaped metal beam nominally 12¼ inches wide by 3¼ inches deep mounted on wood or galvanized steel posts and wood blocks. Additional details are shown in the Standard Plans.

The rail is blocked out from the post with a block. All blocks shall be wood or plastic. Wood line posts are normally 6 inches x 8 inches x 6 feet with the 8-inch dimension installed perpendicular to the rail element. All wood posts and blocks for guardrail must be pressure treated to resist decay. The approved steel post is a galvanized W6 x 9 hot-rolled,

wide-flange post 6½ feet long. Steel posts must be longer than wood posts in order to develop the same soil bearing resistance. Generally only one type of post, either wood or steel, should be used in a run of guardrail.

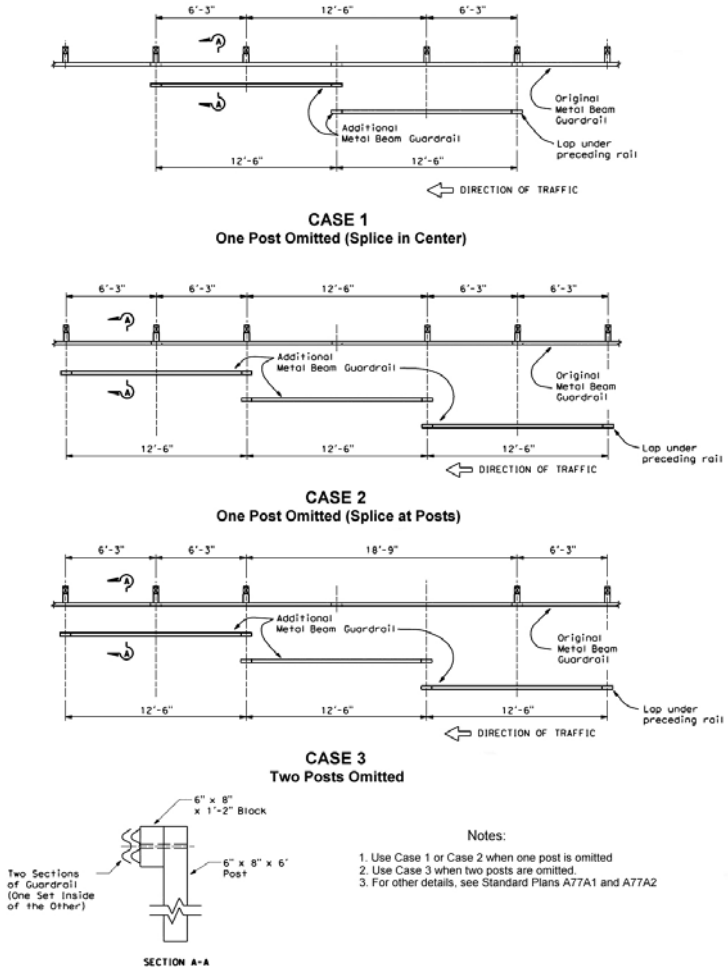
Where embankment width between the edge of shoulder and hinge point is less than 3 feet, there is not sufficient soil to support a standard length guardrail post. If there is at least 2 feet but less than the normal 3 feet of embankment, a 7-foot long, 8-inch x 8-inch wood post should be used. This design may also be used where embankment material is non-cohesive. If there is less than 2 feet between the hinge point and the edge of shoulder, a 2-foot diameter cast-in-drilled-hole pile should be used to support a 6-inch steel post. Use of CIDH piles for guardrail is only by concurrence of the Headquarters' Traffic Liaison. Details for these alternate designs are shown in Figure 7-4, Guardrail on Narrow Embankments. For further details, see the Standard Plans.

Figure 7-4
GUARDRAIL ON NARROW EMBANKMENTS



When it is necessary to continue a roadside guardrail across a low-fill box culvert, pipe culvert or overside drain, full embedment of the guardrail post(s) may not be possible over the culvert due to the shallow soil cover. Posts located in the overside drain are undesirable and are often set back behind the drain with multiple blocks. The use of more than two blocks can cause guardrail rotational problems and should be avoided. One or two posts located directly over the culvert or drain may be eliminated and the guardrail spanning the gap doubled to provide the necessary stability. Design details are shown in Figure 7-5, Long Span Nested Guardrail. This design should not be used in transition areas.

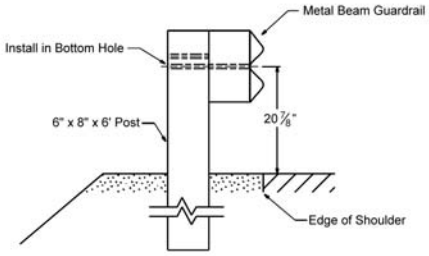
Figure 7-5
LONG SPAN NESTED GUARDRAIL



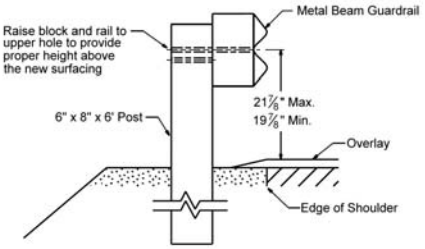
Where larger posts are required in guardrail transitions approaching fixed objects, the wood posts are 10 inches x 10 inches with 8-inch x 8-inch blocks. The alternate steel posts are a W6 x 15 section and the blockouts are 6-inch x 8-inch wood blocks. All steel parts shall be galvanized. Backup plates, which are 12-inch lengths of guardrail, must be used between the rail element and all blockouts at posts without rail splices. This minimizes the possibility of the rail element tearing on the edge of a blockout during an impact. Details of the guardrail transition are shown in the Standard Plans.

Adjustable rail-height guardrail posts may be used where it is anticipated that an overlay will be placed on the shoulder within the next 10 years. The adjustable post has three predrilled holes per the 1995, 1997 and 1999 Standard Plans and two holes per the 2004 and 2006 Standard Plans that allow the rail element and block to be raised when an overlay is placed on the shoulder. Details are shown in the Standard Plans. Figure 7-6

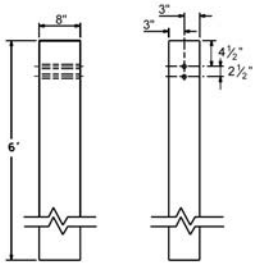
Figure 7-6a
ADJUSTABLE HEIGHT GUARDRAIL (2-HOLE POST)



Initial Installation



Adjusted Rail Height

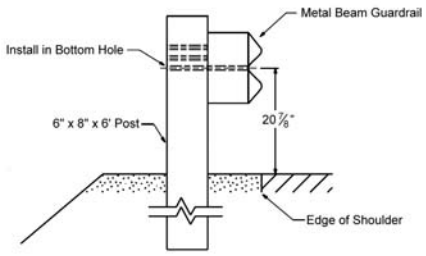


Post Detail

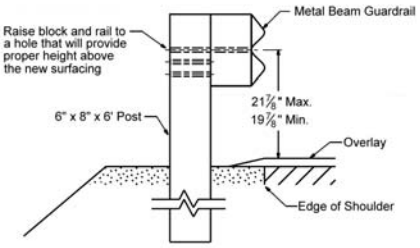
NOTES:

1. All holes in wood posts and blocks shall be ¾" diameter ±1/16"
2. For additional details, see Standard Plans.

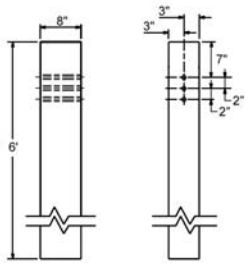
Figure 7-6b
ADJUSTABLE HEIGHT GUARDRAIL (3-HOLE POST)



Initial Installation



Adjusted Rail Height



3-Hole Post Detail

NOTES:
1. All holes in wood posts and blocks shall be ¾" diameter ±1/16"
2. For additional details, see Standard Plans.

Guardrail can be installed on curving alignment without special fabrication where the radius of curvature is more than 150 feet. Where the radius of curvature is 150 feet or less, down to a minimum radius of 5 feet, the rail elements require shop rolling to the required radius. Installations of guardrail with specially fabricated components should be held to a minimum to reduce the need to stockpile special components for maintenance. Also, where special components are not stockpiled, the delay in ordering and receiving replacements unnecessarily extends the exposure for traffic. The rail elements for guardrail are available in two lengths, 12½ feet and 25 feet. The longer elements create problems for later maintenance work because trucks with longer beds are required to haul the rail elements.

Where guardrail is to be installed on an existing highway or in conjunction with existing roadside features, slopes, clearances, dimensions, underground utilities, and material relating to the roadside feature should be verified. This is especially important where connections to existing structures are proposed. Masonry walls and lightly reinforced concrete bridge railing parapets should not be used as anchorage for guardrail. Details for assembling guardrail are shown on the Standard Plans or Special Details of Contract Plans. The layout of guardrail installation should be shown on the Contract Plans.

Galvanized steel guardrail provides some supplemental value as a delineation device. Where necessary, this delineation ability can be enhanced with reflective delineation devices

as described in the California MUTCD. Reflective delineation devices used on guardrail installations should be aimed to provide optimum visibility. Guardrail located more than 12 feet from the roadbed should not have reflective delineation devices installed. Guardrail intruding on the roadbed, such as at approaches to narrow bridges, warrants additional delineation treatment as described in the California MUTCD.

Weathering steel or ungalvanized steel is allowed only under the conditions stated in TOPD 02-02 for new installations or upgrading of guardrail or median barrier on state highways. TOPD 02-02 can be found on the Office of Traffic Safety Program's "Approved Devices and Products" web site.

Thrie Beam Barrier should be used as guardrail only in special situations where additional height of rail is required. The rail elements are 50 percent heavier than metal beam guardrail. It uses a nominal 20-inch wide x 3½-inch deep, three-ribbed, galvanized metal beam with the top of the beam generally 32 inches above the surface beneath the rail. Other installation details are similar to those for metal beam guardrail.

Section 7-04 -- Median Barrier

7-04.1 Purpose

Ideally, median barriers should:

1. Reduce the risk of an out-of-control vehicle crossing the median and colliding with opposing traffic.
2. Reduce the risk of deflection back into the traffic stream of a vehicle colliding with the barrier.
3. Decelerate the errant vehicle within tolerable limits.

While median barriers are capable of preventing nearly all of the cross-median accidents, their installation will result in fixed-object accidents that might not otherwise occur.

7-04.2 Barrier Types

The approved standard types of median barriers for new installation are: (1) concrete median barrier, and (2) thrie beam barrier (single or double). Headquarters approval is required for any new installation or reinstallation of metal beam barrier or cable barrier.

7-04.3 Study Warrants

1. *Freeways*. The median barrier study warrants shown in Figure 7-7 have been developed through extensive study of freeway cross-median accidents. The need for a barrier should be considered on freeways whenever these study warrants are met. Any decision to install or not to install a barrier where study warrants are met should be thoroughly documented.

When the AADT is less than 20,000, the probability of an out-of-control vehicle crossing the median and colliding with an opposing vehicle is low. When the median width is more than 75 feet the probability of an out-of-control vehicle reaching the opposing lanes is low. Barriers in these cases should be considered only if there is an unusually high number or rate of cross-median accidents involving opposing vehicles. A cross-median accident is strictly defined as one in which an out-of-control vehicle crosses the median of a 4 or more lane road and strikes, or is struck by, a vehicle from the opposite direction.

With any AADT or median width, barriers should be considered if there has been a high rate of out-of-control cross-median accidents involving opposing vehicles. A rate based on at least three accidents in 5 years, of 0.5 cross-median accidents per mile per year of any